

VAN GIESON (I)

A Report of the Gross and
Microscopical Examinations
in Six Cases of Death by
Strong Electrical
Currents.

BY

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NEW YORK.

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DR. MACDONALD'S ARTICLE ON
THE INFLICTION OF THE DEATH PENALTY BY MEANS OF ELECTRICITY.

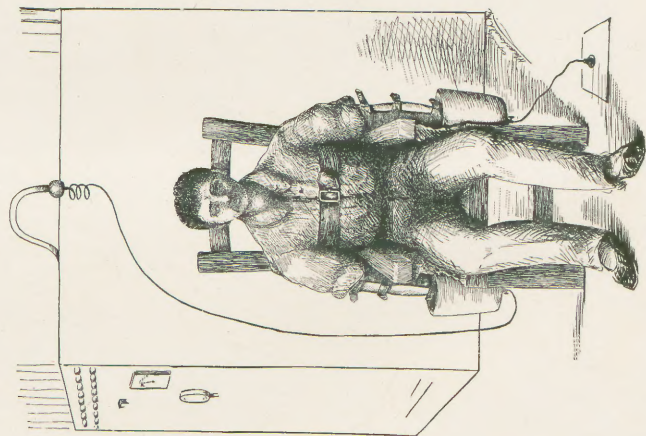


FIG. 1.

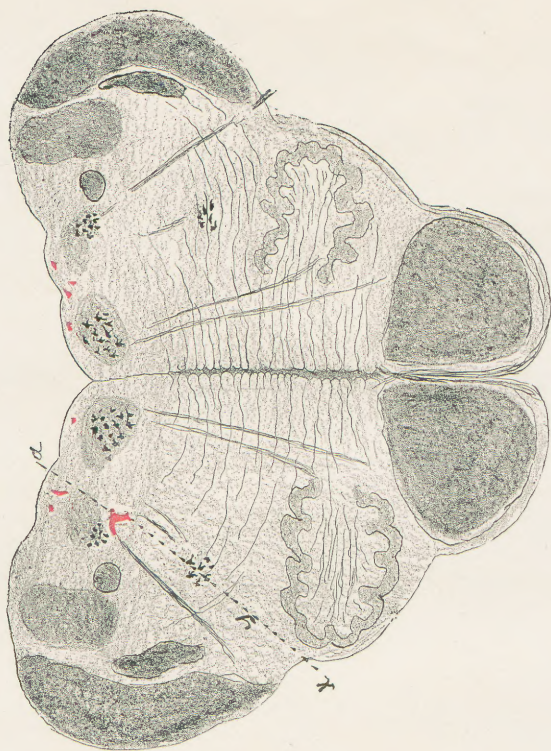


FIG. 3.

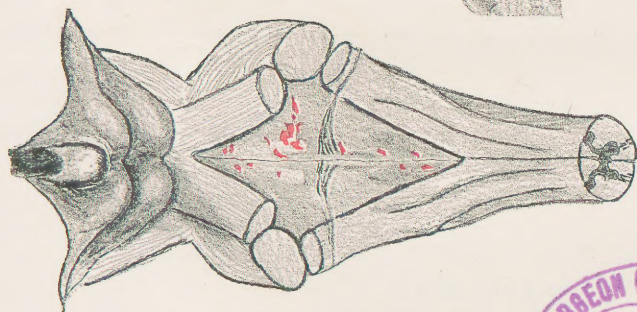


FIG. 2.

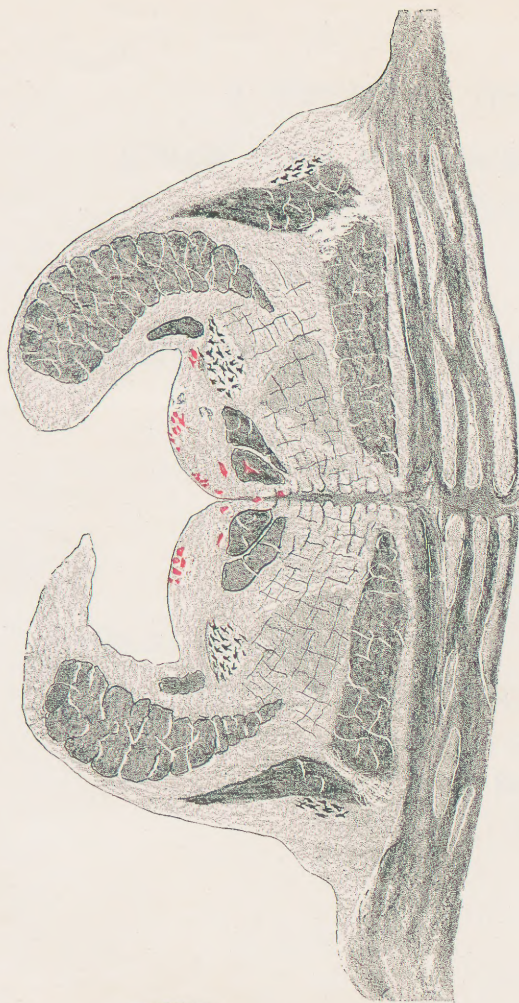
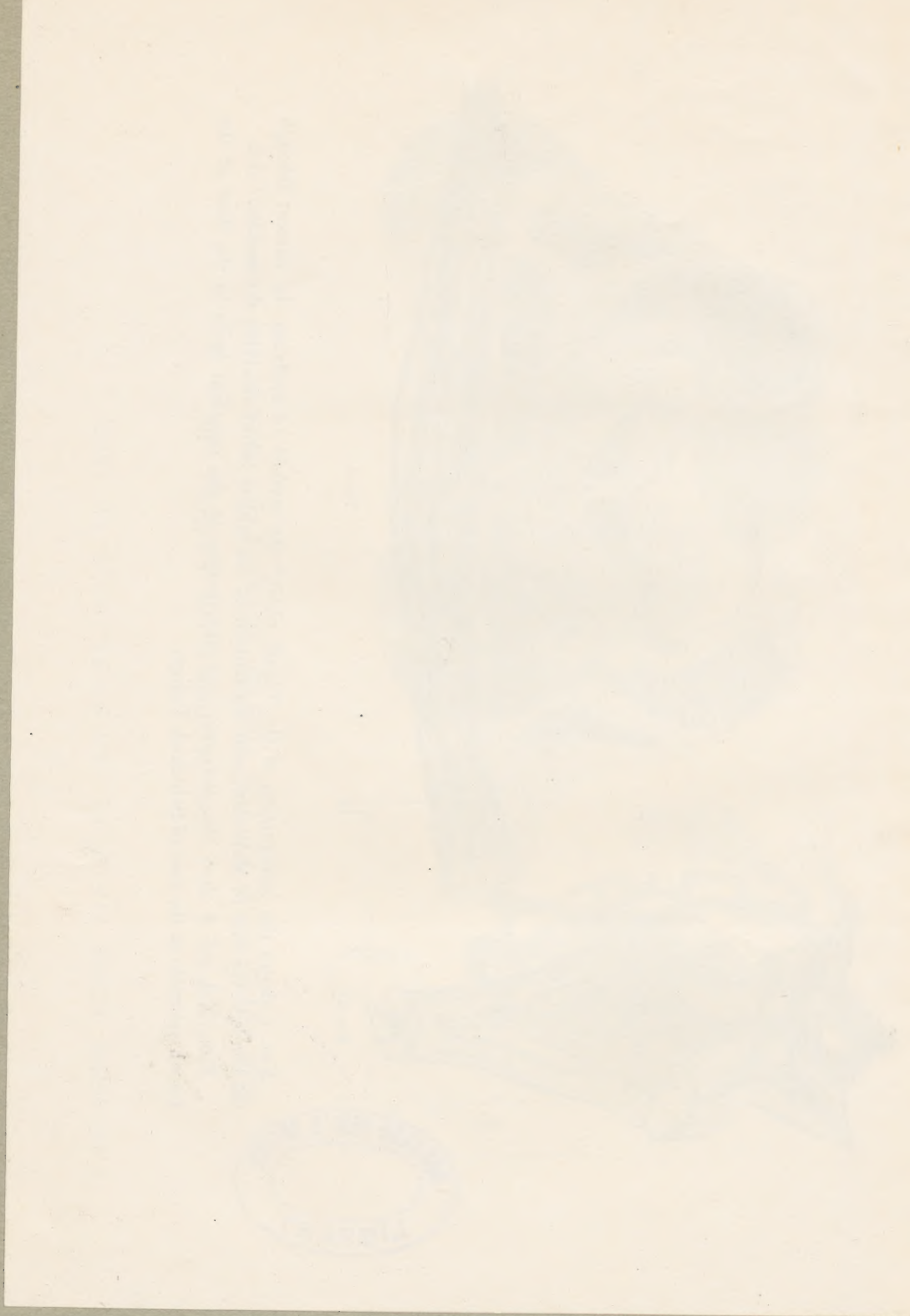


FIG. 4.

FIG. 1 shows the construction of the "death chair," the method of applying the current through the hands in the case of McElvaine, and the attitude of the subject before receiving the contact.

FIGS. 2, 3, and 4 show the character and distribution of the petechial spots in the floor of the fourth ventricle in the case of Schiehiok Jugigo.





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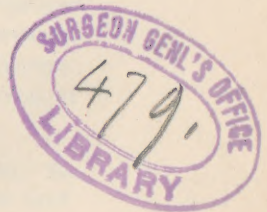


A REPORT OF THE
GROSS AND MICROSCOPICAL
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IN SIX CASES OF
DEATH BY STRONG ELECTRICAL
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A REPORT OF THE GROSS AND MICROSCOPI- CAL EXAMINATIONS IN SIX CASES OF DEATH BY STRONG ELECTRICAL CURRENTS.

THIS official report prepared by the writer is excerpted, by the courteous permission of Dr. Carlos F. MacDonald, from his paper * on The Infliction of the Death Penalty by Means of Electricity, wherein are described the methods of application and effects of the current in the judicial administration of death under the new law in the State of New York, designed to supersede and ameliorate death by hanging.

The increasing death roll attending the progressive use of electricity in the modern arts and industries gives the investigation of the changes, if any, in this form of death some importance and scientific interest. It would also seem of considerable practical value to record a number of carefully made autopsies with microscopical examinations for reference in cases where it might be of medico-legal interest to distinguish death from the current from other forms of death.

Thus, as a contribution to general pathological anatomy, and of possible interest in legal medicine, the examinations of the organs and tissues have been extracted as a separate reprint bearing upon this comparatively new and increasingly frequent form of death inflicted by the currents of modern electrical appliances.

* The Infliction of the Death Penalty by Means of Electricity. Being a Report of Seven Cases. With Remarks on the Methods of Application and the Gross and Microscopical Effects of Electrical Currents of Lethal Energy on the Human Subject. By Carlos F. MacDonald. *New York Medical Journal*, May 14, 1892.

This report comprises the examinations made on the bodies of the six criminals successively executed by the current at Sing Sing Prison in 1891 and 1892, following the first application of the new law in the case of William Kemmler, at Auburn Prison, in August, 1890. These six criminals were Schichiok Jugigo (a Japanese), Harris Smiler, James Slocum, and Joseph Wood (a negro), all executed July 7, 1891; Martin Lippy, December 7, 1891; and Charles McElvaine, February 8, 1892. The details of the application of the current and its physiological effects are to be found in Dr. MacDonald's paper.

It need only be stated here that the current varied in strength from 1,458 to 1,716 volts, while the ammeter registered a variation of 2 to 7 ampères. The subjects sat in a heavy chair (Fig. 1), where they were restrained by soft firm leather straps about the head, arms, chest, and feet. The current was passed in all of the subjects except one (McElvaine) from the forehead to the flexure of the right knee by broad rectangular electrodes (about three by four to four inches and a half in diameter) faced with a sponge moistened in saline solution. The current was applied for a number of seconds, then broken for a few seconds, during which interval the sponges were irrigated to prevent the generation of an undue amount of heat, and then the current was reapplied one or more times. The record of the duration of the contacts is as follows: Jugigo, three contacts of fifteen seconds each; Smiler, four contacts, three of ten seconds each, and the fourth of nineteen seconds; Slocum, two contacts, twenty-seven and twenty-six seconds; Wood, three contacts of twenty seconds each; Lippy, four contacts of fifteen, eleven, fifteen and a half, and ten and a half seconds, respectively.

In the case of McElvaine the first contact was applied through the hands, which were immersed in small pails (Fig. 1) of saline solution, so that the electrodes were liquid, and a second current was passed almost immediately afterward from head to foot, as in the other cases. The first contact lasted fifty seconds, and the second thirty-six seconds.

The contact of the current on the body instantly produced a general rigidity of all the voluntary muscles.

This contraction of the voluntary muscles was exceedingly powerful and intense; each individual muscle fiber seemed to be in an exalted state of tonic spasm. This condition of the muscles lasted until the current was broken, and then the muscles became limp and flaccid; the alternating contraction and relaxation of the muscles occurred simultaneously with each renewed making and breaking of the current.

As a rule, during the contacts enough heat was generated in the electrodes to raise the temperature of the saline solution, so that the skin beneath was slightly damaged, and the blisters described at length in the autopsies were produced in this way.

GROSS EXAMINATIONS.

The autopsies in the first four cases were held four, five, six, and six hours and a half after death, in the order of the subjects classed below. The two remaining autopsies, of Loppy and McElvaine, were held very soon after death—ten or fifteen minutes, or even less time.*

Schichiok Jugigo.—The post-mortem examination in this case was held four hours after death. The pupils were alike and moderately contracted. The body was well nourished and unusually well developed. The anterior epithelial cells of the cornea had desquamated from the central portion by the action of heat. There was a bulging forward of the sclera of the left eye at the left sclero-corneal junction. Conjunctiva anæmic. The scalp and skin covering the neck had a dull, purplish hue. The skin of the anterior surface of the body was not discolored or ecchymosed. At the flexure of both elbows were a number of symmetrical linear ecchymoses, which were more marked on the right side. Also a curved, narrow ecchymotic line just below the outside of the right nipple. These probably were caused by the straps. At the posterior surface of the right knee-joint, and on the posterior and inner and upper surface of the calf, the epidermis was raised, wrinkled, and folded. At the flexure of the knee joint the epidermis had been torn away to the extent of about an inch in diameter. The right lower extremity was flexed and bent more to the median line than its fellow. There is a slight discharge of thin, milky fluid

* In the fifth autopsy I desire to acknowledge the co-operation of my colleague Dr. Hodenpyl.

from the urethra and some still remaining in the canal. A sample of this fluid was taken for microscopical examination. Post-mortem rigidity well marked except in the arms, where it was only slight. The whole posterior surface of neck, trunk, arms, and lower extremities was of a dull, purplish hue. There were a few slight blisters on both temples, and both cheeks and eyelids. There were raised whitish streaks on both sides of the neck, just below the angle of the jaw.

The trunk was opened by a straight incision from the top of the sternum to the pubes. The fat was an inch thick over the abdomen. Muscles red and firm. Diaphragm at left side was found at the level of the sixth intercostal space, and on the right side at the fifth intercostal space. Portions of small intestine were taken for microscopical examination.

Examination of heart: Auricles and ventricles flaccid and in diastole and filled with fluid blood. The larger vessels were tied and the heart removed. The left ventricle was well filled with fluid blood but no clots. The auricles were the same. The blood was of the same color in the left ventricle as in the right. Valves normal. On opening the vessels, a large quantity of dark-colored liquid blood escaped, half filling the pleural cavity. There were no pleural adhesions. Lungs perfectly healthy, but slightly congested.

The spleen was found to be of normal size, the capsule smooth, pulp firm, and uniformly filled with blood, and the arrangement of the Malpighian bodies and splenic connective tissue entirely normal.

The pancreas was perfectly normal and a portion removed for microscopical examination.

Liver entirely normal, and a portion was also removed for microscopical examination.

The gall-bladder was filled with bile.

Left kidney: The capsule was non-adherent. It was rather large and the cortex of normal thickness. The kidney was uniformly injected and the markings in the cortex were normal as to number and arrangement. The right kidney was in the same condition.

The stomach was empty, the mucous membrane pale; the rugæ were well marked and perfectly healthy.

The intestines were healthy. The small intestines were filled with semi-fluid fæces. The large intestines showed the same condition.

The urinary bladder was normal and half full.

Examination of brain: The brain was exposed by a straight incision of scalp over the vertex from ear to ear, and saw cuts through the skull at a slight angle and at the level of the eye-

brows. The scalp showed several old scars, and was slightly less adherent under those portions where the electrode was attached. The skull was symmetrical. The dura mater was normal and the vessels moderately dilated. The longitudinal sinus was found to be normal and contained some fluid blood. The brain was removed in the usual way. The pia mater was uniformly thin and transparent; the vessels in a medium state of congestion; subpial fluid small in amount. The blood was everywhere fluid in the meshes of the pia mater. There was no apparent difference in that portion which the electrode covered. The vessels at the base were perfectly normal. The ventricles contained a small amount of clear fluid. The roof and floor of the lateral ventricles were normal. The ependyma was smooth and transparent. White substance firm. Gray matter normal in every respect. Floor of the fourth ventricle at the upper half contained some dilated vessels, and on the left side there were a number of minute, radiating petechial spots from one to two millimetres in diameter. (See Fig. 1.)

The spinal cord was exposed in the usual manner. The external appearance of both cord and membranes was entirely normal, and the vessels containing, if anything, even less blood than usual, due, probably, to the short time that had elapsed between the occurrence of death and the holding of the autopsy. Sections half an inch apart showed nothing abnormal. A portion of both sciatic nerves was taken for microscopical examination.

Owing to the great length of time necessary to make this autopsy as completely and minutely as was done, and the subsequent careful microscopical examinations, it was not considered necessary to examine the brain and spinal cord in the other cases, especially as nothing of any importance had been observed in these organs in this case.

Harris A. Smiler.—Posterior surface of the body was of the same color, and also showed the same blisters as in the case of Jugigo. The left leg showed the same state of contraction.

The body was opened by the long, straight incision, as in the case of Jugigo. The diaphragm was found at the left side at the sixth intercostal space and on the right side at the fifth intercostal space. The left lung was slightly adherent at the apex. The heart was rather small. The left ventricle was somewhat firmer than the right, which latter was a little flabby. The auricles were distended with fluid blood. The right ventricle was empty and collapsed. The apex of the left lung was small and shrunken and retracted, and contained a few small, scattered, dense, tubercular nodules, some of which were calci-

fied. Otherwise the lung was normal and resembled the preceding case. Right lung shows the same set of changes, but not so marked. Small ecchymotic spots (Tardieu's spots) were observed under the pericardium on surface of left ventricle. The walls of the ventricles were of normal thickness. There were signs of an old endocarditis below the aortic valves. All the valves were healthy.

The spleen was small and the pulp soft and normal.

The pancreas was normal.

The liver was normal both in size and texture.

The left kidney was greatly hypertrophied and the capsule non-adherent. The cortex was somewhat thickened and the markings distinct and regular; moderately congested. The right kidney was small, two and a half by three quarters of an inch in size, and weighed forty-eight grammes—less than an ounce and three quarters. The tissue was normal, but the kidney was apparently congenitally small.

Intestines.—Descending colon was filled with gas; ascending colon and small intestine pallid and contained semi-fluid material.

Stomach contained undigested food, potatoes, etc. Mucous membrane pale and coated with a thin layer of slimy mucus. Bladder distended with urine. Walls and mucous membrane normal.

Examination of brain and cord deemed unnecessary. The blood was fluid everywhere and darker than normal.

Joseph Wood.—Autopsy held at 1.25 P. M.

Body presented same appearance as in preceding cases. There was the same contraction of the legs and the same general appearance as in the others. Same condition of epithelium of cornea.

Median incision made as in other cases. Diaphragm attached to fifth intercostal space on both sides. There were half a dozen scattered petechial points found under the pericardium, half a millimetre in diameter. On the anterior surface of both ventricles and on the posterior surface of the left ventricle were five scattered similar points. On the posterior surface of the right ventricle were three similar small points and one larger, three millimetres and a half in diameter.

Heart normal in size and condition of ventricles the same as in the case of Smiler. Both lungs were free from adhesions. The right lung, bronchi, pulmonary vessels, and lung tissue were normal, but somewhat more pigmented than usual. The substance of the lung was dry and dark pink in color. Heart muscles pale and firm and of normal thickness. All the valves were normal.

Spleen was normal in size and dark red in color, and showed two thickened white patches on capsule. The pulp was firm.

The pancreas was normal.

The liver was normal in every respect.

Both kidneys normal in every respect.

Nothing abnormal was found in the intestines.

The gall-bladder was distended with normal bile.

The urinary bladder was of normal thickness, but the mucous membrane was considerably congested.

The brain and cord were not examined.

James J. Slocum.—Autopsy held at 1.45 P. M. There were the same blisters and external appearances as in the others. There was also the same appearance of cornea. Median incision was made as in the other cases.

Heart.—Petechial spots scattered about as in the other cases, and were also observed under the pulmonary pleura. The left ventricle was firmly contracted, while the right was flabby. Both auricles, especially the right one, were filled with fluid blood. The left lung was free from adhesions. The upper lobe of right lung was slightly adherent. The left lung was in the same condition as the others, but slightly oedematous. The right lung was in the same condition. There was a well-marked large group of petechial spots at the center of anterior surface of left ventricle.

The spleen was of normal size, with the pulp soft, of dark-red color and somewhat congested.

Pancreas was normal both on the surface and on section.

The gall-bladder was half full of bile and the common duct patulous.

The liver was normal in every respect.

The left kidney was very much congested, but normal in all other respects.

The right kidney was in a similar condition.

A careful examination of the intestines showed nothing abnormal.

The bladder was collapsed and normal.

The trachea was normal.

Martin D. Lippy.—Autopsy held as soon as practicable after breaking of the last current. Subject somewhat below the medium stature. Body well nourished. Muscular system well developed. Rigor mortis almost completely, if not entirely, absent, except in the right leg, where there is sufficient muscular rigidity to hold the leg slightly adducted and flexed at the knee joint. The mouth and nostrils are perfectly natural, and show no traces of the extrusion of fluids or frothy material. About

a drachm of viscid fluid, wetting the skin of the pubic region, has escaped from the urethra.

There are no discolorations, contusions, or other marks on the skin, except in two places—viz., (1) at the flexure of the right knee, where the lower electrode was applied, and (2) upon the cheeks, corresponding to the position of one of the restraining straps. The unexposed surfaces of the skin are everywhere else smooth, white, rather thin, and delicate in structure, and show no settling of blood in the dependent portions of the body.

At the flexure (or back part of the knee joint), where the *lower electrode* was applied, there is a diffuse reddish discoloration of the skin about three inches and a half by five inches in diameter. This region of the skin shows a very moderate, superficial, irregular separation of the thin outer scarf skin or epidermis from the true and thicker skin beneath. The epidermis or scarf skin in this region is raised up and corrugated, and it can be easily rubbed off with slight force. When the whole thickness of the skin is cut through with a knife, it can be seen that this change is quite superficial, affecting the outer scarf skin only, and does not damage the corium or true skin beneath to any appreciable extent.

The corium or true thicker skin underlying the electrode region is soft, pliable, not desiccated, and seems to be normal in every way, except that it is somewhat congested, which produces the reddish discoloration in this region.

The layer of fat beneath the skin in the electrode region is in no way changed or damaged.

The *head electrode* has left no traces upon the skin. The forehead and scalp beneath the electrode are perfectly white and natural, and there are absolutely none of the superficial alterations referred to above at the knee joint.

There is redness and swelling of both cheeks just beneath the eyes, which is very moderate in extent and not enough to make any distortion of the face. This was occasioned by pressure against one of the leather restraining straps during the periods of muscular activity when the current was applied.

The right eye had been lost some time previously during life. The eyelids are closed; skin of eyelids intact. Anterior corneal epithelium of the left eye cloudy, but not detached. The eyeball is perfectly natural; it has the proper tension and contour.

The interior of the mouth is normal. The tongue and the teeth show no signs whatsoever of injury.

The body was opened in the usual way. The abdominal organs were critically examined first, then the thoracic vis-

cera, and finally the brain and upper portion of the spinal cord.

The *stomach* is normal; it is much contracted, rather small; mucosa pallid; fundus smooth; pyloric extremity folded.

The *small intestine* is normal, contracted, upper portion nearly empty, lower portion partially filled with semi-fluid fæcal matter.

The *spleen* contains, just beneath the normal capsule, several larger and smaller hæmorrhagic spots, from one millimetre to three millimetres in diameter, such as are not infrequently found after death from a variety of causes. The substance of the spleen is normal.

The *pancreas* is normal in size and texture.

The *liver* is normal in size, and uniformly filled with blood; cut surface smooth, stroma and parenchyma unchanged. *Gall-bladder* normal; partially filled with bile.

The *kidneys* are of medium size; capsules non-adherent; vessels well filled; the cortex is normal in thickness, and has its constituent elements properly arranged.

The *suprarenal capsules* are unchanged.

The *urinary bladder* shows no abnormalities; it is much contracted and its mucosa pallid.

Heart.—The left ventricle is firmly contracted and empty; both auricles and the left ventricle are flaccid. The right ventricle contains a little fluid blood. Two small thickened patches of old endocarditis are at the base of the aortic valve. The heart muscle is firm and normal.

The *diaphragm* stands at the level of the sixth intercostal space on the left side, and at the sixth rib on the right side.

The *lungs* are non-adherent, pale, normal in size, texture, and consistence.

The *trachea*, *œsophagus*, and *aorta* are normal.

The *vocal cords* are in cadaveric position.

Brain and Spinal Cord.—The brain was removed in the ordinarily practiced method, and the scalp, pericranium, and skull show no effects of the head electrode. Skull brachycephalic. Dura mater of convexity normal. Longitudinal sinus normal; contains a little fluid blood. Pia mater not thickened, but contains a number of nebulous striæ and opacities uniformly scattered over the whole convexity. There was considerable subpial fluid. Both this change in the pia mater and the increased subpial fluid are referable to some pre-existing condition, and are such as are not infrequently found in persons having the age and intemperate habits of this subject.

Convulsions of the brain have the normal topographical

distribution; substance of brain normal, both as to the conditions of the blood-vessels and the character of both the gray and white matter. Vessels at base normal. Lateral ventricles contain a slight amount of clear fluid. Ependyma of all ventricles unchanged. Floor of fourth ventricle normal.

The right optic nerve—corresponding to the lost eye—is atrophied, having about half of its ordinary thickness. The medulla, pons, and basal ganglia show no abnormalities. (These were referred to Dr. Brill for microscopical examination.)

There is an old healed fracture extending across the right orbital process of the frontal bone, one centimetre from the median line, which extends backward and outward nearly to the apex of the petrous portion of the temporal bone for a distance of about five centimetres. The dura mater along the track of this old fracture is slightly thickened (to the extent of three millimetres) and adherent to the bone.

The superior portion of the *spinal cord* shows no changes in its coverings, vessels, or substance.

The muscles were critically examined to determine if there were any signs of violence induced by the current or the contraction it caused, and with a negative result. The muscles of the chest, abdomen, and calf were normal, bright red, firm, and show not the slightest tearing or rupture.

Charles McElwaine.—Approximately two to three minutes after the breaking of the last current the reflex action of the voluntary muscles was tested as follows:

1. The patellar reflex was tried in the usual way without any response from the muscles either in the knee of the electrode side, which was rigid, or the knee of the other side, which was relaxed.

2. The cornea was touched with the finger without eliciting any exertion from the muscles of the eyelids.

3. The nipples were pinched with a forceps, and the surrounding skin was scratched and lightly scarified with fine scissors; but this did not induce any motion of the muscle groups, or even any fine fibrillary twitching of the individual fibers of the subjacent muscles.

4. One of the muscles of the abdomen (the rectus) was exposed, but showed no activity when cut or irritated with the knife. Voluntary muscle reflexes to ordinary stimuli were absent. The activity of smooth or involuntary muscle was *not* interfered with; thus peristalsis of the intestines and the cremasteric reflex could be excited.

After these tests the autopsy was made immediately.

I. External Appearances of the Body.—The subject is a trifle below the medium stature, well nourished, has no deformities,

and has well-developed muscular system. The lips are pallid, but the nostrils and interior of the mouth are perfectly natural. The left eyelid is quite firmly closed, while the other lid is partly open. The delicate membrane coating the front of the cornea has not been disturbed by the head electrode. The pupils are about midway open, nearly uniform, and measure about two millimetres and a half in diameter. The eyeballs are natural. There is no distortion of the face, such as muscular contractions or marks of violence, to mar the countenance.

Rigor mortis is marked only where the current was applied; the electrode leg is flexed at the knee joint at an angle of about 90°, and is a trifle adducted. The arms, which received the first contact, are less flexed than the knee joint, and the fingers are almost completely closed in the palm of the hand.

There are no evidences of a seminal emission.

The skin is everywhere perfectly natural, except at the points of application of the electrodes, and here there are some superficial changes in the outer layers of the skin. In these places, at the back part of the right knee joint and on the upper surface of the wrists (where the first contact was made), the thin outer scarf skin is wrinkled and raised up or partially detached from the true or deeper skin beneath.

These superficial patches on the skin in the electrode regions are not extensive and do not measure more than two to two inches and a half in diameter. In order to see if these patches involved the skin beyond the outer layers, the whole skin was cut through with the knife and looked at critically. It was then seen that the deeper layers of the skin were but very little involved. The deeper or true skin is in places in these patches a little drier than it ought to be, and this is all. The layer of fat beneath the slightly superficially damaged patches on the skin is perfectly normal in every way.

II. *Examination of the Thoracic and Abdominal Organs.*—There is very little to be said about the examination of these organs other than that they were subjected to a thoroughly detailed systematic scrutiny, and nothing abnormal was found either about their shape, consistency, or texture, except the left ventricle of the heart was firmly contracted, while the right ventricle was flaccid. Valves and heart muscle normal.

The left kidney (measuring 6 × 13 centimetres in diameter) contained a number of larger and smaller cavities (the largest one centimetre and a half in diameter) near the region of the pelvis, some of which contain calculi. Such a condition of the kidney is due to an old chronic previous process, and is to be expected in persons who develop calculi in the kidney.

All of the viscera and organs of the thorax and abdomen were examined.

III. *The Central Nervous System.*—The brain is brachycephalic and is perfectly normal as to its coverings, in the disposition and structure of its blood-vessels, in the arrangement of the convolutions, fissures, and sulci, and in the texture and relative distribution of the gray and white matter. The fourth ventricle and its floor are normal. The superior portion of the spinal cord is normal. (The brain was not completely dissected, in order that it might be transported to Professor Donaldson, of Clarke University.) The brain with the pia weighed, on scales weighing to half a gramme, 1,442 grammes. The dura mater weighed 52 grammes.

IV. *The Muscular System.*—The muscles are red and firm and show no signs of tearing, rupture, or hæmorrhage.

Remarks.—In looking carefully over the details of this autopsy and comparing this report with that of the four previous cases of infliction of the death penalty by electricity, the following points may be noted :

1. The passage of an electrical current of the pressure employed in these cases (of approximately from 1,400 to 1,700 volts) and in this manner does not do any damage to any of the internal organs, tissues, or muscles. None of these parts are lacerated or changed in volume; neither are there any gross chemical or morphological changes or alteration of their finer structural features.

2. The local thermic effects of the electrodes are limited to the outer scarf skin. The true skin beneath is not damaged to any appreciable extent. The epidermis or scarf skin may be separated from the deeper skin, and resembles in this way an ordinary blister from which the fluid has escaped. The blisters about the knee in this case are like the ordinary familiar water blisters on the hands from friction, or the blisters which physicians often have occasion to produce in their treatment of disease. Where the skin has been exposed to the weather, and is tougher and more resistant, as on the forehead and scalp, the blistering does not take place, whereas in the more sensitive delicate skin of unexposed surfaces, as at the fold of the knee joint or the calf, the superficial blistering is more readily induced. Compared with the four previous executions, the changes in the skin induced by the local thermic action of the electrode are even still less in degree in this case, and may be pronounced altogether trivial.

3. The occurrence and distribution of the minute hæmorrhagic spots (described more completely in the previous cases) are not a uniform or constant feature in these cases, and as they

are found after death from the greatest variety of causes, they can not properly be regarded as positively characteristic of death by this method.

4. The attitude of the body on the autopsy table is peculiar and very uniform. When the electrodes are applied at the knee flexure, the leg is invariably slightly flexed at the knee and a trifle adducted.

5. The rapid abolition of reflex action of the voluntary muscles tends to show how superlatively complete and far-reaching the effects of the currents are in abolishing life, not only in the concrete form, but also in the integral activities of the body which in other forms of sudden and violent death is liable to persist for a time after life is extinct. From observations at these executions, as well as at the subsequent examination of the bodies, the current appears at first not only to extinguish life in the ordinary sense of the word, so far as consciousness, feeling, and volition are concerned, with overwhelming suddenness, but reaches beyond this and destroys the energies of the individual component parts of the body so that they can not be raised into activity by artificial mechanical stimulation, as is usually the case in sudden violent death.

MICROSCOPICAL EXAMINATION.

The practical results of the microscopical examination are, that the passage of the electric current through the body is attended with no recognizable changes in its tissues or organs, excepting the local thermic changes in the skin at the points of application of the electrodes and some minute petechial spots on several of the organs.

Such a summary of the examination, however, seems insufficient without adding that it was determined by most exhaustive and modern investigation, and as there are apparently no recorded examinations of similar cases in medical literature, it seems not inappropriate to give the detailed report subjoined, showing in what way and to what extent the tissues were examined.

Specimens were taken from all four of the subjects, but the material from the Japanese criminal was especially selected for minute study, as it could be obtained the soonest after death.

Notes about the technical preparation of tissues are added at the conclusion of the report.

The Examination of the Cells in General.—For this purpose the ciliated cells of the trachea, the liver cells, and the ganglion cells were studied especially with the oil-immersion lens. The physical properties of the protoplasm are in no way changed.

The arrangement of the protoplasm, its volume, consistency, its behavior with light and staining reagents, are not at all different from the ordinary cell body. The same may be said of the constituent elements of the nucleus. None of the cells in any of the tissues examined show any signs of mechanical violence, such as tearing, fracture, or disintegration of the protoplasm. Neither does there appear to be any chemical change in the nucleus or cell body, as far as can be determined with micro-chemical methods. (The cells thus studied were prepared with solutions of corrosive sublimate, and also osmic acid.)

The Blood.—The blood cells are not damaged in any way by the current. The red cells have their normal size and shape. The white cells are uniformly spherical and have the usual arrangement of the nuclei. The blood was very perfectly preserved, even the blood plaques being unchanged.

The stomach, small intestine, and kidney are unchanged, with the exception of a slight amount of post-mortem degeneration in the parenchyma cells. The stomach shows the appearances of functional activity.

The liver and pancreas and spleen show no changes.

The Muscular System.—The smooth muscles, studied from the gastro-intestinal tracts and the heart muscle fibers, are unchanged.

In sections of the eyelid lying directly beneath the electrode the voluntary muscle fibers are normal.

The blood-vessels are not altered. *The lungs and genital organs* were not examined microscopically. The fluid ejaculated from the urethra in the case of the Japanese criminal does not show spermatozoa.

The central nervous system was examined with especial care. It has recently been determined that, during periods of muscular fatigue or prolonged muscular exertion, certain of the motor-ganglion cells are diminished in volume, which is recovered again during periods of muscular repose. Speaking roughly, this shrinkage of the ganglion cells during muscular fatigue represents a sort of mechanical equivalent of the work done by the muscles. Hodge (*Am. Jour. of Psychology*, May, 1888, 1889, and 1891), in inducing experimentally the effects of fatigue in ganglion cells by the prolonged action of weak electrical currents, found that the ganglion cells suffered a vacuolation, shrinkage in the volume of the cell body, and a still greater reduction in the size of the nucleus. This diminution of the ganglion cell was tangible enough and could be measured, and in some cases in Hodge's experiments with the current on cats the nucleus shrank to 43.9 per cent. of its original bulk.

Although it could hardly be expected that there would be

time enough for the ganglion cells of these criminals to show traces of the intense muscular contractions, yet the ganglion cells of the central convolutions and the anterior spinal cornua were very carefully examined to see if there would be any shrinkage coincident with the expenditure of so great an amount of muscular energy as was manifested during the contacts.

The ganglion cells in these regions, however, as far as can be determined by careful comparison with sections from the same regions in other ordinary healthy subjects, seem to be normal in size, or at least do not show any striking reduction in volume. A slight shrinkage may be present, but it would be almost impossible to determine it from the lack of a normal standard to make measurements with. Concerning this suspected change in the ganglion cells, then, it may be said that if there is any shrinkage at all, it is of very limited extent.

At the autopsy some minute petechial spots were found on the floor of the fourth ventricle (Fig. 1). Microscopically, these spots are small masses of extravasated red blood-cells, situated, for the most part, in the perivascular spaces just beneath the ependyma.

The diagrams show the distribution and character of those hæmorrhages well enough, so that we may omit detailed description of them. A few of the extravasations are more deeply situated and have a more significant position with regard to the important nuclear groups in the medulla. Fig. 2*a* shows one of the hæmorrhages just on the outskirts of the sensory vagus, and other smaller ones close to the hypoglossal nuclei. The extravasation near the vagus is confined by the perivascular space of the median lateral artery of the medulla, which takes the course of the dotted line *x, y*, in Fig. 2.

These hæmorrhages look as if due to the passage of blood along the perivascular spaces, and out into the tissues after rupture of a small vein or capillary, but whether any especial significance should be attached to these hæmorrhages, or whether they are caused directly by the current, or by intense muscular tension, or by manipulation in removing the brain, are questions extremely difficult to decide about.

The Peripheral Nerves.—The sciatic nerves from both sides were examined without finding any change or difference between the sciatic of the electrode side and its fellow.

The delicate structures of the *retina* lying so close to the electrode are not altered.

The skin beneath the electrode is but slightly changed. The epidermis is absent or raised up from the corium and has a dried-up appearance. The corium, structurally, is nearly normal; the connective-tissue nuclei are not shrunken and stain

well, but the connective-tissue bundles and fibers seemed changed chemically and behave abnormally with certain staining reagents. The sweat glands are degenerated to a considerable extent; they have a desiccated appearance.

It would then appear from this examination that, beyond the scalding effects of the electrodes, electric currents passed through the body in this way produce no change in the body except minute petechiæ, and it is doubtful if these are not some indirect or secondary consequence of the current. The results of the microscopical examination of the two remaining subjects—Loppy and McElvaine—are corroborative in every way of this examination.

It seems proper to add that the central nervous system of only one of the first four cases was removed, because nothing was found in it which would receive any further elucidation from the examination of the other three cases.

METHODS OF THE PREPARATION OF THE SPECIMENS.

The Blood.—Two drops from a glass rod dipped in the freshly cut right ventricle were received in a one-per-cent. aqueous osmic-acid solution.

The sciatic nerves were prepared in the same medium by gently pulling short fasciculi out of their lamellar sheaths, allowing the acid to penetrate.

The Central Nervous System.—Thin shavings of the convolutions and of the cervical spinal cord were placed in alcoholic and aqueous solutions of corrosive sublimate of different strength for periods of time varying from an hour to several days. Exceedingly small portions of the gray matter were also hardened in Fleming's osmic-acid mixture and in one-per-cent. osmic-acid solution for half an hour. All of the specimens were subsequently hardened in eighty per cent., and then in strong alcohol.

Still other portions of the convolutions were scraped gently with a sharp razor, so that the gray matter was reduced to a thick pulpy broth on the edge of the razor. This pulp was then shaken into exceedingly fine fragments in osmic acid and sublimate solutions, so that the fixation of the ganglion cells would be as nearly as possible uniform and instantaneous. (Incidentally, attention may be called to this method as giving very good results for ganglion cells, and being much better than the ordinary methods of hardening the cortex in blocks; no matter how small.)

The medulla and portions of the cord were also hardened in Müller's fluid in the usual way. The *trachea*, *thoracic* and *abdominal* viscera were prepared in sublimate solution, and also

with strong alcohol in the ordinary way. Portions of the *spleen*, *pancreas*, and *liver* were also injected interstitially with osmic-acid solution. The eyeball, *eyelid*, and *singed portions* of the *integument* beneath the electrodes, were prepared with Müller's fluid.

All of these variously hardened portions of the tissues were imbedded in celloidin and sections stained appropriately with several different methods, such as Weigert's method, double staining with hæmatoxylon and eosin, and also with the picro-acid fuchsin method.

PATHOLOGICAL LABORATORY OF THE
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COLUMBIA COLLEGE, *April 1, 1892.*

The first of these is the fact that the United States is a young nation, and that its history is a history of growth and development. The second is the fact that the United States is a nation of immigrants, and that its history is a history of the struggle for a better life.

The third is the fact that the United States is a nation of free men, and that its history is a history of the struggle for freedom. The fourth is the fact that the United States is a nation of peace-loving people, and that its history is a history of the struggle for peace.

The fifth is the fact that the United States is a nation of progress, and that its history is a history of the struggle for progress. The sixth is the fact that the United States is a nation of justice, and that its history is a history of the struggle for justice.

The seventh is the fact that the United States is a nation of love, and that its history is a history of the struggle for love. The eighth is the fact that the United States is a nation of hope, and that its history is a history of the struggle for hope.

The ninth is the fact that the United States is a nation of faith, and that its history is a history of the struggle for faith. The tenth is the fact that the United States is a nation of courage, and that its history is a history of the struggle for courage.

The eleventh is the fact that the United States is a nation of strength, and that its history is a history of the struggle for strength. The twelfth is the fact that the United States is a nation of wisdom, and that its history is a history of the struggle for wisdom.

The thirteenth is the fact that the United States is a nation of beauty, and that its history is a history of the struggle for beauty. The fourteenth is the fact that the United States is a nation of truth, and that its history is a history of the struggle for truth.

The fifteenth is the fact that the United States is a nation of goodness, and that its history is a history of the struggle for goodness. The sixteenth is the fact that the United States is a nation of kindness, and that its history is a history of the struggle for kindness.

The seventeenth is the fact that the United States is a nation of compassion, and that its history is a history of the struggle for compassion. The eighteenth is the fact that the United States is a nation of mercy, and that its history is a history of the struggle for mercy.



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